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# **Gravel Pit and Other Sandy And Droughty Site Renovation Trials and Experiences in New Hampshire**

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## Gravel Pit and Other Sandy and Droughty Site Renovation Trials and Experiences in New Hampshire

Over 15,000 acres of borrow pits and other areas such as cut and fill slopes exist in New Hampshire. Individuals, groups, communities, and the state are concerned about this situation.

In 1979, the New Hampshire Legislature enacted RSA 155-E that provided for the regulation of commercial excavations of earth by local governments.

One requirement of the law is the revegetation of excavated sites within 12 months of completion of the excavation or expiration of the permit. In fact, it is not typically possible to meet this time limit and end with long term vegetative cover on droughty and sandy portions of excavated or filled slopes.

Most regulations call for cool-season plants such as fescues, redtop, crownvetch, and birdsfoot trefoil. Investigations by the Natural Resources Conservation Service in New Hampshire and surrounding states show that these species and most other cool-season plants will not survive in a soil environment where there is less than 15-percent fines (passing the 200-mesh screen). Such sites are droughty and often contain no organic matter in the surface soil material.

### **A SEARCH FOR EFFECTIVE HERBACEOUS COVER**

In 1976, 1977, and 1978, ten plantings were made in six northeast states comparing six cool-season

grasses, six warm-season grasses, and four legumes. Study methods, results, and discussion is presented in a paper by F.B. Gaffney and J.A. Dickerson titled Species Selection for Revegetating Sand and Gravel Mines in the Northeast States.

Conclusions of this study having relevance to roadsides and borrow pits in New Hampshire that consist of droughty sands or gravels were:

(1) Cool-season grasses, when planted alone, are not effective long-term species.

(2) Where fines (particles passing the 200-mesh sieve) are greater than 15-percent, legumes such as flatpea, crownvetch, and the trefoils are much more effective than the cool-season grasses tested in this study. Additional study has identified other effective warm season grasses.

(3) Where fines are less than 10 percent, switchgrass and big and little bluestem represent the only effective herbaceous species for long term, low-maintenance cover identified in this study.

(4) The long term need for fertilizer appears less with warm-season grasses than with cool-season grasses.

Prior to these plantings, Blackwell Switchgrass was seeded on three dams in New Hampshire as follows:

1962 Souhegan Site #19

1968 Souhegan Site #12  
(Temple Water Supply)

1968 Baker Site #8

In 1984, a need to reseed droughty, sandy portions of dams owned by the State of New Hampshire stimulated a new look at the potential for using warm-season grasses. Queries by the New Hampshire Department of Transportation in 1985 provided additional incentive for establishing field trials of numerous warm-season species on similar sites.

Following is a listing of trials established in New Hampshire:

1984 ~ Franklin. (Gravel Pit)  
Replicated no-till drilled plots of Blackwell Switchgrass, Aldous Little Bluestem, Nebraska 54 Indiangrass, and Niagara Big Bluestem.

1984 ~ Franklin. (Sand Pit)  
Replicated hand seeded plots of Holt, Oto, and Nebraska 54 Indiangrass; Aldous and Cimarron Little Bluestem; Goldstrike Sand Bluestem; Nebraska 27 Sand Lovegrass; Champ and Niagara Big Bluestem; Blackwell Switchgrass; Trailway and El Reno Sideoats Grama, and Tioga Deertongue.

1984 ~ Alton. (Sand Pit)  
Hydroseeded Aldous Little Bluestem, Nebraska 54 Indiangrass, Blackwell Switchgrass, Niagara Big Bluestem, Tioga Deertongue, and Viking Birdsfoot Trefoil.

1985 ~ Ossipee. (Log Landing)  
Replicated hand seeded plots of Holt, Oto, and Nebraska 54 Indiangrass; Aldous and Cimarron Little Bluestem;

Blackwell Switchgrass; Trailway and El Reno Sideoats Grama, and Tioga Deertongue.

1985 ~ Canterbury. (Floodplain Sands)  
Replicated hand seeded plots of Holt, Oto, and Nebraska 54 Indiangrass; Aldous and Cimarron Little Bluestem; Goldstrike Sand Bluestem; Nebraska 27 Sand Lovegrass; Champ and Niagara Big Bluestem; Blackwell Switchgrass; Trailway and El Reno Sideoats Grama, and Tioga Deertongue.

1985 ~ Penacook Morrill Farm. (Sand Dunes)  
No-till drilled Blackwell and NJ 50 Switchgrasses.

1985 ~ Lyndeborough. (Constructed Sand Spillway)  
No-till drilled NJ 50 and Cave-in-Rock Switchgrasses, Niagara Big Bluestem, Nebraska 54 Indiangrass, and Cimarron Little Bluestem.

1986 ~ Wentworth. (Constructed Dam Face)  
Hand seeded dam face with Aldous Little Bluestem, Niagara Big Bluestem, Blackwell Switchgrass, Nebraska 54 Indiangrass, and Empire Birdsfoot Trefoil.

1986 ~ Dunbarton. (Constructed Sand Embankment)  
Hydroseeded Blackwell Switchgrass, Nebraska 54 Indiangrass, Niagara Big Bluestem, Aldous Little Bluestem, and Bend Sand Lovegrass.

1987 ~ Concord. (Roadside Sand Slope)  
Walked in fertility trials of Blackwell Switchgrass, Niagara Big Bluestem, Garden Sand Bluestem, Aldous Little Bluestem, Nebraska 27 Sand Lovegrass, and Golden Jubilee Blackeyed Susan.

1988 ~ Franklin. (Sand Pit) Hand seeded small plots (10' x 10') in replicates of three of Shelter, Trailblazer, Blackwell, Pathfinder, Cave-in-Rock, and Alamo Switchgrasses; Roundtree, Kaw, North Dakota 64, and Niagara Big Bluestems; El Reno and Pierre Sideoats Gramas; Osage, Nebraska 54, Rumsey, North Dakota 444, and Oto Indiangrasses; Goldstrike and Garden Sand Bluestems; Nebraska 27 and Bend Sand Lovegrasses; Caucasian Bluestem; and Cochise Atherstone Lovegrass. In addition, three plots of a cool-season grass, Barton Western Wheatgrass, were seeded.

1988 ~ Farmington. (Sand Pit) Hand seeded small plots (10' x 10') in replicates of three of Shelter Trailblazer, Blackwell, Pathfinder, Cave-in-Rock, and Alamo Switchgrasses; Roundtree, Kaw, North Dakota 64, and Niagara Big Bluestems; El Reno and Pierre Sideoats Gramas; Osage, Nebraska 54, Rumsey, North Dakota 444, and Oto Indiangrasses; Goldstrike and Garden Sand Bluestems; Nebraska 27 and Bend Sand Lovegrasses; Caucasian Bluestem; and Cochise Atherstone Lovegrass. In addition, three plots of a cool-season grass, Barton Western Wheatgrass, were seeded. Plots of two commonly seeded cool-season mixes were also seeded.

1989 ~ Franklin. (Sand Pit) Tracked mixture of warm-season grasses.

1989 ~ Loudon. (Sand and Gravel Pit) Tracked mixtures of warm-season grasses and birdsfoot trefoil, yellow sweet clover, and crownvetch. Coastal panicgrass was tried for the

first time with good first season success. Replicated plots using jells were also established.

1990 ~ Belmont. (Sand Pit) Hand seeded small plots (10' x 10') in replicates of three of Shelter, Trailblazer, Blackwell, Pathfinder, Cave-in-Rock and Alamo Switchgrasses; Roundtree, Kaw, North Dakota 64, and Niagara Big Bluestems; El Reno and Pierre Sideoats Gramas; Osage, Nebraska 54, Rumsey, North Dakota 444, and Oto Indiangrasses; Goldstrike and Garden Sand Bluestems; Nebraska 27 and Bend Sand Lovegrasses; Caucasian Bluestem; and Cochise Atherstone Lovegrass. In addition, three plots of a cool-season grass, Barton Western Wheatgrass, were seeded. Plots of two commonly seeded cool-season mixes were also seeded. Cool-season and warm-season mixes and tracking trials were also conducted in this site.

1990 ~ Ossipee. (Stocked Sand Piles) Five acres of steep washed sand spoil piles were walked in with a mixture of Trailblazer Switchgrass, Bend Sand Lovegrass, and Kaw Big Bluestem.

1990 ~ Wolfeboro. (Sand Pit) Fertility and nurse crop trials were established using Caucasian Bluestem as a nurse crop with Shelter Switchgrass, Atlantic Coastal Panicgrass, Niagara Big Bluestem, and Nebraska-27 Sand Lovegrass.

1990 ~ Loudon. (Sand and Gravel Pit) Hydroseeding plantings with and without mulch were established.

1985 – 1989. More than 20 New Hampshire Department of Transportation slopes seeded to warm-

season grass trials in addition to those listed above.

### **WARM-SEASON GRASS BACKGROUND**

(1) Warm-season grass seed germinates at a minimum soil temperature of about 60 degrees Fahrenheit. On sands and gravels in New Hampshire, these temperatures are achieved earlier in the season than on agricultural soils.

(2) These plants make most of their growth during the heat of summer while most cool-season grass growth occurs in spring and fall months. Above ground growth of mature plants typically occurs after May 15 in New Hampshire.

(3) Warm-season grasses grow down, not up the seeding year. The top growth typically amounts to a narrow straight leaf until late in the summer. These seedlings can be difficult to see even for experienced growers. Inexperienced growers almost always are convinced they have a failure the first year. Most of the time they actually have the start of a good seed stand. Patience must be a part of the vegetative establishment process for consultants, seeding (vegetative establishment) contractors, purchasers of services, and community representatives administering ordinances and regulations. The rewards on droughty sandy and or gravelly sites are long term vegetation versus the short-term vegetation of cool-season plants.

### **GROWING WARM-SEASON GRASSES IN DROUGHTY SAND AND GRAVEL IN NEW HAMPSHIRE**

Droughty sand and gravel substratum material provides a far different environment for growing warm-season grasses than the silty and clayey topsoils of their native environment of the Midwest. Keys to the success of these plants are deep root systems that develop rapidly after germination, large root systems, apparent low fertility requirements, the ability to thrive during hot summer months, and low pH requirements.

The plot trials established between 1984 and 1990 are revealing species, varieties, seeding techniques, fertilizer requirements, and cost information useful in providing plant cover on droughty, sandy, and gravelly surfaces in the state.

#### ***Species***

Switchgrass, Coastal Panicgrass, Indiangrass, Big Bluestem, Sand Bluestem, Little Bluestem, Deertongue, and Sand Lovegrass will grow well when established in droughty sands and gravels of borrow pits and other cut and fill slopes. Seed of these plants is commercially available.

#### ***Varieties***

Selecting suitable varieties for a climatic situation is as critical as selecting a species. For example, "Trailblazer" Switchgrass establishes well in most of New Hampshire, but "Alamo" Switchgrass Winter-Kill.

## **ESTABLISHMENT, SEED GERMINATION, AND SEEDLING DEVELOPMENT**

Seed germination appears to be dependent on about a 2-week period of moistened seed at a time when soil temperatures have reached 60 degrees Fahrenheit. In droughty sand and gravel, the surface two to three inches of the seedbed is too dry most of the time to keep the seed moist long enough to germinate. While most warm-season grass seed will remain viable in or on the soil for several years, it will not germinate until prolonged moisture is available at warm temperatures. Consequently, it may be the spring after seeding before seedlings are observed. In fact, it is usually the second year when the success of a seeding becomes evident.

### **SEEDING METHODS AND OTHER CONSIDERATIONS**

#### ***Mulch***

Mulch is not an answer to a moist seedbed. Seedling development was best without the use of grass or straw mulch in the few comparisons tried.

#### **Observations:**

- (1) In New Hampshire trials, there was little soil moisture difference with or without mulch.
- (2) The soil seedbed beneath the mulch was much cooler than the soil seedbed without mulch.
- (3) Where mulch was disced as an anchoring technique, it seemed to act as a wicking agent causing the soil in slits to remain dry for extended

periods. Germination was poor in the slits.

- (4) Except for hydroseeding efforts, mulch is not currently recommended in New Hampshire for warm-season grasses seeded on droughty sands and gravels.

#### ***Compaction***

Concerns about soil compaction around the seed are addressed in the various seeding methods tried. These methods include:

- (1) loose raking of seed, lime, and fertilizer;
- (2) walking in the seed, lime, and fertilizer on steep, loose, sandy slopes;
- (3) tracking a site with a farm tractor with deep knob type tires after the seed, lime, and fertilizer were applied;
- (4) tracking many sites with bulldozers having deep grousers or cleats after the seed, lime, and fertilizer were applied;
- (5) no till drilling,
- (6) hydroseeding numerous sites.

#### ***Loose raking***

The raking of seed, lime, and fertilizer by hand has worked well on several hundred small plots (10'x10'). It works well where topsoil or composted sludge is used.

#### ***Walking in***

Walking back and forth across the slope has worked well where slopes are steep, sandy, and loose. This

method works on stockpiled washed sand and other slopes too steep and loose for effective tracking with bulldozers.

### ***Tracking with a farm tractor***

Complete failure. No better than throwing the seed on the ground surface and walking away. Insignificant compaction around seed observed.

### ***Tracking with bulldozers***

This is by far the most dependable method for assuring the success of a warm-season grass seeding on droughty, sand, and/or gravelly sites based on New Hampshire trials. Large or small dozers work well on nearly level sites. Large dozers are necessary on steep slopes. Small dozers slip, loosening the seedbed rather than pressing the seed into the ground surface on steep slopes. Dozers movement should be up and down the slope. In this setting, seedlings develop in the grouser tracks apparently benefiting from compaction, seed covering from sand washed and blown into the tracks, and perhaps lime and fertilizer also moved with the sand particles. The grouser tracks provide an important function of reducing erosion during the seedling establishment period. Never track a site after applying hay or straw mulch. The pressed in material keeps the track dry and inhibits germination.

### ***Drilling***

Results are mixed with two sites rated excellent and two sites rated poor for seedling establishment. Reasons for the failures were not evident. Drilling

requires special seeding equipment for seeds with awns such as Big Bluestem, Little Bluestem, and Indiangrass. Switchgrass, Panicgrass, and Sand Lovegrass work well in the Tye and Moore no till seeders providing the drive works in the sand. Although switchgrass seed in a Tye drill was placed two and three inches deep in sand dunes, seedlings developed in the drill rows. Sand blowing against or accumulating on the seedlings subsequently killed many plants in this trial; however, the seeding method worked.

### ***Hydroseeding***

All seed readily passes through the hydroseeder nozzle, thus facilitating the use of awned seed species. This appears at this time to be the easiest method for distributing lime and fertilizer on long steep slopes.

The search is still on to select techniques that will consistently result in acceptable seedling distribution. Hydroseeding seed, lime, and fertilizer followed by the application of hay or straw mulch and tackifier is more weather dependent for success than other methods involving seed incorporation. A reason for this may be the germination process. Seed laying on top of the ground sends out a thin rootlet that in many instances grows over a quarter of an inch on the surface before moving downward into the soil. This exposed rootlet often dried out in trials in the dry microclimate of sand and gravel pits. Many potential seedlings were lost in this phase of development. A seeding technique under investigation to improve hydroseeding results involves tracking the site prior to application of the various materials.

## PLANT POPULATION

### ***Warm Season Grasses***

In evaluating warm-season grass plantings, a minimum of one vigorously growing plant per three square feet should be looked for four years after seeding. This plant population will provide adequate erosion control, visual enhancement, and animal habitat to satisfy knowledgeable evaluators. Most warm-season plantings will have higher plant densities.

### ***Cool Season Species***

A look at numerous gravel pits seeded in prior years to cool-season grass and legume mixtures revealed red fescue to be the only consistent surviving species where there are less than 15-percent fines. This plant provided poor ground cover in all cases due to poor vigor and inadequate population for the species. Seeded birdsfoot trefoil, tall fescue, perennial ryegrass, redbud,

and annual ryegrass were mostly missing from these sites.

Several contractor experiences with annual ryegrass demonstrate why this plant should not be included in seeding mixtures used on New Hampshire droughty sands and gravels. This plant can be so aggressive under droughty conditions as to prevent other species from getting a start. Since it will die over winter, a long term seeding failure occurs.

Perennial ryegrass is a very short-lived perennial plant under droughty conditions in New Hampshire. When used with warm-season grass plant populations compared to control plots.

The planting of American Beachgrass Culms and subsequent development on these soils is a success story. This plant spreads by rhizomes and is useful in stabilizing the toe of slopes having accumulating sand, and in reducing wind damage to other seeded species. It is useful in small area plantings such as sand blowouts due to funneled wind on interstate road systems.